TETHYS ENGINEERING BLAST

26 March 2021

Tethys Engineering is an online knowledge base that facilitates the exchange and dissemination of information on the technical and engineering aspects of marine renewable energy (MRE). The bi-weekly *Tethys Engineering* Blast highlights new publications in the *Tethys Engineering* Knowledge Base; relevant announcements, opportunities, and upcoming events; and news articles of international interest. If you have specific content you would like circulated to the greater MRE community, please send it to tethys@pnnl.gov for consideration.

Announcements

Marine Energy Collegiate Competition

The U.S. Department of Energy's (DOE) Marine Energy Collegiate Competition (MECC): Powering the Blue Economy will open for applications for the 2022 competition on 5 April 2021. The MECC encourages multidisciplinary teams of undergraduate and graduate students to unlock the power of the ocean, rivers, and tides to develop, design, and test the technologies that build resilient coastal communities and provide power at sea. Applications will close 7 May 2021.

Calls for Abstracts

The Marine Technology Society and IEEE (Institute of Electrical and Electronics Engineers) Oceanic Engineering Society are now accepting abstract submissions for the Global OCEANS 2021 Conference & Exhibition. OCEANS 2021 will take place 20-23 September 2021 in San Diego, California (US) and virtually. Abstracts are due 19 April 2021.

The Partnership for Research In Marine Renewable Energy (PRIMaRE) is now accepting abstracts for the 8th PRIMaRE Conference. Submissions are due by 30 April 2021. The 8th PRIMaRE Conference will take place online on 29-30 June 2021.

Funding/Testing Opportunities

Sustainable Energy Authority of Ireland (SEAI) has launched a €10 million funding call to support innovative energy research, development, and demonstration (RD&D) projects, including ocean energy, offshore wind, and green hydrogen-related developments. Applications for the SEAI RD&D Funding Programme Call are due by 3:00pm BST (2:00pm UTC) on 29 March 2021.

The U.S. DOE recently announced $115 million for small businesses pursuing clean energy research and development projects through its Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs. This funding opportunity is open to small businesses that have previously received SBIR or STTR grants to compete for additional funding. Letters of Intent are due by 5:00pm EDT (9:00pm UTC) on 31 March 2021.

The U.S. DOE has allocated $100 million in funding through the Advanced Research Projects Agency-Energy's (ARPA-E) 2021 OPEN Funding Opportunity to support the development of potentially disruptive new technologies across the full spectrum of energy applications. Concept papers are due by 9:30am EDT (1:30pm UTC) on 6 April 2021.

INORE (the International Network on Offshore Renewable Energy) recently announced the 2021 Call for BECS (Blue Energy Collaborative Scholarships) proposals sponsored by OES (Ocean Energy Systems). The BECS grant, up to €1000, will enable collaboration between INOREans and can be put towards travel expenses and accommodation, or to fund remote work. The call closes on 9 April 2021.

The Interreg Atlantic Area's Blue-GIFT has extended the deadline for the Third Call for Applications to test MRE technologies at the project's test sites. This access will allow developers to perform low cost tests and validation of their floating offshore wind, wave, tidal, or floating solar energy technologies in real sea environments. Applications now close at 5:00pm UTC on 23 April 2021.

The Testing Expertise and Access for Marine Energy Research (TEAMER) program, sponsored by the U.S. DOE and directed by the Pacific Ocean Energy Trust (POET), will begin accepting applications for its Request for Technical Support (RFTS) 3 on 9 April 2021. RFTS 3 applications will be accepted through 9 May 2021.

Employment Opportunities

Nova Innovation is recruiting for a Production Technician – Team Leader, Mechanical Design Engineer, and Mechanical CAD/Design Engineer.

Simply Blue Energy is seeking an Engineering Manager and a Consenting Manager with experience in the offshore wind and wave energy industry. Applications are due 30 March 2021.

The Environmental Research Institute (ERI) at the University of the Highlands and Islands (UHI) is recruiting for a Research Fellow in Marine Renewable Energy and the Environment to

join the multi-disciplinary team working across engineering, marine sensing, hydrodynamics and robotics to study environmental and bio-physical interactions. Applications are due 5 April 2021.

The University of Plymouth is inviting applications for a 3.5-year MPhil/PhD studentship aimed at developing physical and numerical modelling tools to characterise the behaviour of on dynamic export cables for floating offshore renewable energy farms. Applications are due 19 April 2021.

Upcoming Events

Upcoming Workshop

The Health and Safety Executive (HSE) and Supergen Offshore Renewable Energy (ORE) Hub are organizing a virtual Health and Safety Research in Offshore Renewables Workshop on 11 May 2021 from 2:00-5:00pm BST (1:00-4:00pm UTC). Register your interest in attending here by 5:00pm BST on 12 April 2021.

Upcoming Webinars

The National Hydropower Association is hosting a Path to Clean Energy Virtual Event, "The Vast Potential of Marine Energy", at 12:00pm EDT (4:00pm UTC) on 30 March 2021. During the event, top officials within the U.S. DOE's Waterpower Technologies Office (WPTO), National Labs, Ocean Energy Europe, and technology developers will discuss the potential market opportunities for marine energy. Register here.

The U.S. DOE WPTO is hosting a R&D Deep Dive Webinar Series to share updates on tools, analysis, and emerging technologies to advance marine energy as well as next generation hydropower and pumped storage systems.

- Register here for "Summary of Marine and Hydrokinetic (MHK) Composites Testing at Montana State University" on 26 March 2021 at 1:00pm EDT (5:00pm UTC).
- Register here for "Introduction to Working with the U.S. Department of Energy: A Deep Dive into Hydropower and Marine Energy Opportunities for Students, Researchers, and Faculty" on 6 April at 1:00pm EDT (5:00pm UTC).
- Register here for "Leveraging the Advantages of Additive Manufacturing to Produce Advanced Composite Structures for Marine Energy Systems" on 9 April at 1:00pm EDT (5:00pm UTC).

The Ocean Exchange and the Marine Technology Society are hosting a joint webinar series entitled, *Engaging with the Blue Economy*. The next webinar in the series will focus on mobile power generation energy and will take place at 11:00am EDT (3:00pm UTC) on 7 April 2021. Register here.

The International Energy Agency's (IEA's) Ocean Energy Systems (OES) is hosting a webinar series focused on ocean energy projects and key policies on IEA-OES Member Countries. The

first webinar, "Ocean Energy Outlook in U.S.A, Canada and Mexico", will take place from 4:00-5:00pm UTC on 14 April 2021. Register here.

ETIP Ocean (The European Technology and Innovation Platform for Ocean Energy) is hosting a webinar on sharing data to attract investors at 10:00am UTC on 15 April 2021. During the webinar, ocean energy professionals will share their experience and discuss what type of information investors and public authorities are looking for. Register here.

Upcoming Conferences

Energía Marina and its Marine Energy Research & Innovation Center (MERIC) are organizing an online international conference, Chile Riding the Blue Energy Wave, on 12-13 April 2021. Register for free here.

The International Conference on Ocean Energy (ICOE) will be held online from 28-30 April 2021. The theme for ICOE 2021 is "Energizing a Powerful Blue Economy". Register here by 31 March 2021 for early bird rates.

New Documents on *Tethys Engineering*

Tidal stream energy resource characterization in the Salish Sea – Yang et al. 2021

> The Salish Sea, a large estuary on the Pacific Northwest coast, represents a great tidal stream resource because of its strong tidal currents in many tidal channels. However, the tidal energy resource in the Salish Sea has not been systematically characterized. This paper presents a modeling study conducted to characterize the tidal energy resource in the Salish Sea based on a high-resolution tidal hydrodynamic model, which was validated using data derived from 10 tide gauges and 132 current stations. A total of 16 tidal channels with strong currents were identified as hotspots for potential tidal energy development in the Salish Sea.

Counterweight-pendulum energy harvester with reduced resonance frequency for unmanned surface vehicles – Graves et al. 2021

> In this paper, a novel electromagnetic pendulum energy harvester with a counterweight is designed to harvest low frequency vibration from ocean waves for unmanned surface vehicles. This design is the first of its kind, allowing the natural resonant frequency of the pendulum to be reduced without increasing its length, thereby maintaining a high power output from the energy harvester at lower frequencies than previously possible with pendulums of the same size. Implementing a novel mechanical rotation rectifier (MRR) system for a high energy conversion efficiency, this counterweight pendulum energy harvester can provide multi-watt-level power at frequencies lower than 1 Hz, with a primary pendulum arm length of just 195mm.

Synergy analysis for ion selectivity in nanofluidic salinity gradient energy harvesting – Long et al. 2021

> For salinity gradient energy harvesting, membrane ion selectivity plays an important role, which is often qualitatively analysed via the electric double layer (EDL) overlapping degree in conventional studies. However, the degree of EDL overlapping is hard to be quantitatively evaluated. Here, we systematically analyze the synergy relations between physical vectors that determining the energy conversion process to quantitatively illustrate the EDL overlapping degree and ion selectivity. Three synergy angles are proposed to describe the synergy relations between the ion diffusion and the electrostatic migration driven forces.

A standardised tidal-stream power curve, optimised for the global resource – Lewis et al. 2021

> Tidal-stream energy resource can be predicted deterministically, provided tidal harmonics and turbine-device characteristics are known. Many turbine designs exist, all having different characteristics (e.g. rated speed), which creates uncertainty in resource assessment or renewable energy system-design decision-making. A standardised normalised tidal-stream power-density curve was parameterised with data from 14 operational horizontal-axis turbines (e.g. mean cut-in speed was ~30% of rated speed). Applying FES2014 global tidal data (1/16° gridded resolution) up to 25 km from the coast, allowed optimal turbine rated speed assessment.

Mooring Analysis of a Floating OWC Wave Energy Converter – Pols et al. 2021

> This investigation focuses on the modelling of a floating oscillating water column (FOWC) wave energy converter with a numerical code (ANSYS AQWA) based on potential flow theory. Free-floating motions predicted by the numerical model were validated against experimental data extrapolated from a 1:36 scale model device in regular and irregular sea states. Upon validation, an assessment of the device's motions when dynamically coupled with a four-line catenary mooring arrangement was conducted at different incident wave angles and sea states ranging from operational to survivable conditions, including the simulation of the failure of a single mooring line.

Energy, exergy and exergoeconomic analysis of a combined cooling, desalination and power system – Zhou et al. 2020

> Ocean thermal energy has attracted much attention for its unique advantages. Multi-generation systems are emerging as an effective solution to further improve energy efficiency and economy of ocean thermal energy conversion (OTEC) system. In this paper, a novel hybrid OTEC system combing cooling, desalination and power (CCDP) is proposed facing the actual demands of remote islands at low latitudes. The cogeneration of cooling capacity, fresh water and power are achieved by the subsystems of ejector refrigeration cycle (ERC), multi-effect distillation (MED) desalination and organic

Rankine cycle (ORC). A detailed mathematical model for the proposed system is developed based on the thermodynamics and exergoeconomics.

News & Press Releases

Tidal powered cars driving Scotland to net zero – Nova Innovation

Global leaders in tidal energy Nova Innovation have announced that vehicles in Shetland are now fuelled by the power of the sea. The marine energy experts have created the first ever electric vehicle (EV) charge point where drivers can 'fill up' directly from a tidal energy source. The EV charge point is located on the scenic shores of Bluemull Sound, at Cullivoe harbour on the island of Yell in Shetland. Beneath the water, Nova's tidal turbines have been powering homes and businesses in Shetland for more than five years. The Nova project has received grant funding through Transport Scotland to install the EV charging infrastructure as part of the clean energy transition.

Marine Energy Infrastructure Lab Call Selection – U.S. DOE

On March 22, WPTO announced a total of $7.1M will be awarded to 7 projects across 5 DOE national labs. The project selections were made as a result of a competitive call to the national labs, issued in December 2020, designed to invest in lab infrastructure in support of advancing marine energy technologies. The limited availability of marine energy testing infrastructure is a critical challenge to the advancement of marine energy technologies, as it severely limits the ability of technology developers to quickly assess the performance of devices and components, innovate solutions where necessary, and deploy the next generation of devices.

Wave-powered breakwater hits water offshore Norway – Offshore Energy

The multi-purpose Powerpier solution, designed to offer protection from waves while exploiting them to produce clean power, has been installed offshore the Norwegian town of Ålesund. The Powerpier project, led by Norwegian company Marina Solutions with partners Havkraft and Ulstein Betong Marine, has been installed on site late last week, the partners informed. The test pier, dubbed Ulsteinflåten, has been equipped with two Havkraft Wave Energy Converter (H-WEC) units boasting six impulse turbines with Bosch permanent magnet generators. The testing will take place for a few months, before the Powerpier product is offered to a wider market.

EPSRC funds eight projects to unlock the potential of marine wave energy – Supergen ORE

Eight new projects have been launched to develop and test cutting-edge new wave energy technologies to help the UK achieve its net zero goal. These projects will build on the UK's leading role in marine wave energy to overcome challenges to devices that capture the energy generated by waves and convert it into a renewable source of electricity. Other

projects will test the performance of WECs through ocean-based trials and develop the models needed to assess how they cope with conditions such as storm waves. The research is supported by a £7.5 million investment by the Engineering and Physical Sciences Research Council (EPSRC), part of UK Research and Innovation (UKRI).

Seabased and ORE Catapult Complete Wave-to-Wire Simulation Software – Seabased

Seabased and the Offshore Renewable Energy (ORE) Catapult have created a new software tool that can help Seabased optimize its wave energy system from wave to grid. The new tool will move Seabased toward its anticipated third-party commercial certification at the end of 2021. When combined with the test bench currently under development, with continued engineering support from ORE Catapult, it will allow Seabased to quantify the amount of power customers can expect from our technology in any given wave climate. Seabased wave energy technology comprises a buoy on the surface that, when lifted by a wave, raises a translator inside a generator on the sea floor, producing electrical power.